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I.—*A Contribution to the Pterylography of the Tinamiformes.* By W. P. PYCRAFT, M.B.O.U., Assistant to the Linacre Professor of Comparative Anatomy, Oxford.

(Plates I.—III.)

SOME time since, Dr. Sclater forwarded me an adult and two nestlings of the Martineta Tinamou, *Calodromas elegans*, and, later on, an adult of the Rufous Tinamou, *Rhynchotis rufescens*, requesting at the same time that I would furnish him with a report thereon for the pages of 'The Ibis.'

The present paper may be considered as the first section of this report, and describes the pterylosis of these birds. I have assumed, as a matter of course, that my readers are acquainted with the salient features of the science of pterylography, and therefore I have not attempted to preface my descriptions with introductory remarks appertaining thereto.

My investigations have been carried out in the laboratories of the Department of Comparative Anatomy of the Museum, at such odd moments as I could manage to spare from other and more pressing work, and thus, perhaps, my apparent

sloth will be considered to have been satisfactorily explained away.

For purposes of convenience it will be expedient to describe the pterylosis of the adult specimens first, commencing with—

1. CALODROMAS ELEGANS. (Plates I., II.)

Pterylæ:—

Pt. capitis (Pl. I., *Pt.cap.*).—The plumage of the head is produced forward on each side of the beak into a conical process, terminating at the posterior angle of the external nares. The two processes enclose between them a large portion of the cere*. The eyelids are provided with eyelashes.

The feathers of the inter-ramal space are collected into a distinct tract, with a relatively wide apterion on either side; at a point corresponding to the angle of the gape the apterion ends abruptly, the plumage blending with that of the side of the head and neck.

Pt. spinalis (Pl. II., *Pt.s.*).—Arising at the nape of the neck, it divides soon afterwards into two long narrow tracts enclosing a space†. Coalescing between the humeral tracts, they soon after again divide, and at the same time increase greatly in width. Just in front of the thigh a branch is sent down to the femoral tract, the main stems of the tract retaining their independence for a short distance further, and then fuse at a point roughly corresponding with a line drawn across the back from the acetabulum. The remainder of the tract is now continued backwards, finally to blend with the *pteryla caudæ* (Pl. II. fig. 1).

Pt. caudalis (Pl. II., *Pt.c.*).—The rectrices are but little longer or stronger than their coverts, and not easily distinguished. They are 10 in number.

*Pt. colli lateralis** (Pl. I., Pl. II., *Pt.col.lat.*).—The lateral cervical tract, at its upper end, fuses in the mid-ventral line with that of the opposite side, whilst the dorsal

* See *Rhamphotheca*, p. 8.

† See *Apt. spinalis*, p. 5.

margin, for about half its length, has blended with the pt. spinalis. At the shoulder-joint it gives off a short thick branch to the pt. humeralis above, and passes below into the pt. ventralis.

Pt. ventralis.—This is divided into a strong, narrow, outer, and a broad, but weaker, inner branch*, the two being separated by a narrow apterion. The outer branch passes into the pt. femoralis, sending at the same time sharply forward a narrow double row of feathers to join the hypopteron. The inner tract is probably continued down to the anus, but the bird having been eviscerated, this region was too much disturbed to afford trustworthy data.

Pt. femoralis (Pl. I., Pl. II., *Pt.f.*).—This is a very strongly developed tract of long, thick-shafted feathers. It is not continued posteriorly beyond a point corresponding to the free end of the pubis. From the anterior margin is given off a comparatively broad branch to join the pt. spinalis, from which it is otherwise separated by a broad apterion †.

Pt. cruralis (Pl. I., Pl. II., *Pt.cr.*).—This tract is confluent above with that of the pt. femoralis; the feathers composing it are of a weaker texture than those of the pt. femoralis and sparsely distributed.

Pt. humeralis (Pl. II., *Pt.h.*).—Tapers to a point posteriorly; in front is confluent with the short upper branch of the pt. colli lateralis.

Pt. alaris:—

Metacarpo-digital remiges or primaries.—These are 10 in number. The tenth is relatively long, and, like all the other primaries, is much curved and sharp-pointed. The sixth remex is the longest. All are longer than the cubitals, to be described below, giving the outstretched wing a deeply indented outline.

Cubital remiges or secondaries.—Some 20 in number.

* The "strength" or "weakness" of a tract is a purely arbitrary distinction, depending upon the relative size and development of its component feathers.

† See *Apt. trunci lateralis*, p. 6.

The first feather is conspicuously shorter than the succeeding remiges (save the most proximal), but the difference is not so marked as in Gallinæ. Fifth cubital present.

Tectrices. Upper surface:—

T. majores.—Well developed. Those of the manus much longer and stouter than those of the cubitus.

T. mediæ.—Those of primaries 1 to 3 suppressed. The remainder, though small, yet retain their pennaceous character. On the cubitus they almost equal the *T. majores* in length and robustness.

T. minores.—About 5 to 6 cubital rows; they are absent on the manus. Overlap uncertain.

T. marginales.—There are several rows of this series on the cubitus. Along the anterior margin they bridge over the broad apterion, dividing the pt. alaris from the pt. humeralis. Overlap distal. On the manus they are confined to two rows running along the preaxial border.

Parapteron (Pl. II., *Par.*).—I cannot yet speak definitely as to this group; indeed it is difficult to say where the remiges and their coverts cease and the parapteron begins, the two groups are so gently graded one into another. If we determine the homologies of these feathers simply by their serial arrangement, then the cubital remiges and coverts might be said to be continued right up the arm to the humeral tract! Each “remex” would have a dorsal major covert, and a ventral major and median covert. There are six such groups of “remiges” and coverts, forming the parapteron.

The difficulties of this question are increased by the fact that the most proximal cubitals are, as usual, much reduced in length, the innermost and penultimate remiges being smaller than their coverts. All the feathers in the parapteron seem to have an aftershaft; in this, of course, they agree with all the remaining feathers of the wing (and trunk), save the remiges. Later on I hope to be able to speak more definitely on this interesting, though apparently unimportant point*.

* For the literature of this group, see Nos. 1, 2, 3, 4, 5 of References.

Ventral surface:—

T. majores.—Those of the manus longer and stouter than those of the cubitus.

T. mediæ.—Present only on the cubitus. They lie almost parallel with the arm, and are concealed by the *T. minores*. They are nearly as long as the major coverts, and still retain the pennaceous character.

T. minores.—There are four imperfect rows on the cubitus, two on the manus. The first row is situated at the base of the median coverts of the cubitus and the major coverts of the manus. The second row is situated close behind the first, and ceases proximally in the region of the thirteenth cubital remex. The third commences at a point corresponding to the level of the third cubital remex. Distally the row is continued on to the manus. The fourth row is divided from the preceding by a broad bare space; the feathers are wide apart, and scarcely succeed in concealing the skin. This row terminates at a point corresponding to the insertion of the ninth cubital remex.

T. marginales.—On the cubitus the first row of these coverts forms one side of a triangle, enclosing a bare space; the opposite side of the triangle is formed by the fourth row of minor coverts, and the base (imperfectly) by the axillary feathers (*Hypopteron*); the feathers along the preaxial side of the triangle are very long and conceal the otherwise naked surface of the patagium.

There are five rows of marginal coverts on the cubitus, but only two on the manus, these running along the preaxial border.

Hypopteron (Pl. I., *Hp.*).—A single row of five feathers, connected with the outer branch of the pt. ventralis by a double row of irregularly arranged feathers (see p. 3).

Carpal covert and remex (5) both present; the former much the smaller; both are closely approximated one to the other and to the first metacarpal remex.

The wing is quinto-cubital (2, 6, 8).

Apteria of trunk:—

Apt. spinalis (Pl. I., *Apt.sp.*).—This arises at the upper

end of the neck, over the region of the 2nd and 3rd vertebræ, and is continued downwards to a point corresponding with a line drawn across the back from the acetabulum. It is very narrow, and is interrupted between the shoulders by the fusion of the two branches of the pt. spinalis.

Apt. colli lateralis (Pl. I., *Apt.c.lat.*).—Arising rather below the middle of the neck, it almost immediately passes into the space dividing the humeral from the spinal tract (= the dorsal moiety of the apt. trunci lateralis, see below).

Apt. mesogastræi (Pl. I., *Apt.m.*).—Arising from the middle of the neck, it extends in the median line uninterruptedly (?) to the pt. caudæ*.

Apt. trunci lateralis (Pl. I., Pl. II., *Apt.t.lat.*).—A large space embracing the whole side of the trunk, but divided, more or less completely, into two portions. The first of these two segments may be said to arise at the summit of the shoulder, and extends backwards to the anterior margin of the femoral tract; here it turns sharply forward, and serves to divide the humeral from the spinal tracts; it finally terminates in the apt. colli lateralis. The second moiety arises between the two branches of the pt. ventralis; running backwards between the leg and trunk, it sweeps round the femoral tract and serves to divide it from the pt. spinalis. The first of these two spaces, as will be noticed (Pl. II.), is more or less completely subdivided by a double row of feathers from the outer branch of the pt. ventralis to the hypopteron †.

Apteria of wing:—

Apt. alæ superioris.—Divides the wing-feathers from those of the trunk, but a narrow band of feathers from the t. marginales, along the anterior margin of the patagium, connects the wing-tract with the humeral tract in front,

* Owing to dissection, this region is much disturbed.

† Owing to the fact that the figure is a trifle out of drawing in the region below the wing, the extent of this great space is somewhat obscured in Plate I.

whilst the hypopteron performs a similar office at the margin of the posterior wing-membrane.

Apt. alæ inferioris (Pl. I., *Apt.a.inf.*).—May be said to embrace nearly the whole of the under-wing surface. In life it is more or less effectually concealed by the posterior row of elongated marginal coverts and the two or three, more or less imperfect and widely separated, rows of t. minores. This space is also somewhat interrupted by the hypopteron (Pl. I., *Hp.*), which joins the double row of feathers previously described (p. 3) as given off by the pt. ventralis (outer branch).

Uropygium (Pl. I., Pl. II., *U.*).—Only the elliptical tip of the oil-gland projects beyond the general contour of the body; this is surmounted by four long, but closely approximated, oil-agglutinated tufts of feathers.

Filoplumes.—A few long ones occur round the base of the remiges.

Pulviplumes or powder-down-feathers entirely absent (see p. 17).

Plumulæ or Down-feathers:—

Distribution.—Down-feathers are entirely absent on the trunk, but occur on the wing-tract; here, however, they are strictly confined to the base of the major coverts and remiges. There is a down-feather at the base of each major covert throughout the series, two on the dorsum of every cubital remex, and one in a like position on every primary remex.

Structure.—The down-feathers possess a long calamus or quill, which breaks up, in the region of the upper umbilicus, into a large number of very long rami. There is no rhachis. The rami bear numerous and moderately long tapering radii, apparently made up of a number of short segments, joined end to end; these segments, proximally, are exceedingly compressed from side to side, so as to be blade-like or strap-shaped; distally they decrease in width, terminating in a long, fine, free filament. The distal end of every segment appears to be slightly thickened, as if to receive the base of

the segment next beyond it, and, further, to have the dorsal and ventral margins produced forwards into two short blunt processes, representing cilia of more highly developed feathers (Pl. III. fig. 2).

Semiplumæ.—These occur very sparingly. I find some three to four fringing the upper margin of the pt. femoralis, and a similar number along the margin of the pt. spinalis opposite, where they occupy much the same position as do the powder-down-feathers of Nitzsch (see p. 17). The structure of the radii agrees precisely with that of the down-feathers.

Thick-shafted Feathers.—The rachis of some of the contour-feathers, notably those of the pt. spinalis, is much thickened (Pl. I., Pl. II.).

Accessory and ornamental Plumes.—There is a tuft of elongated feathers arising from the crown of the head.

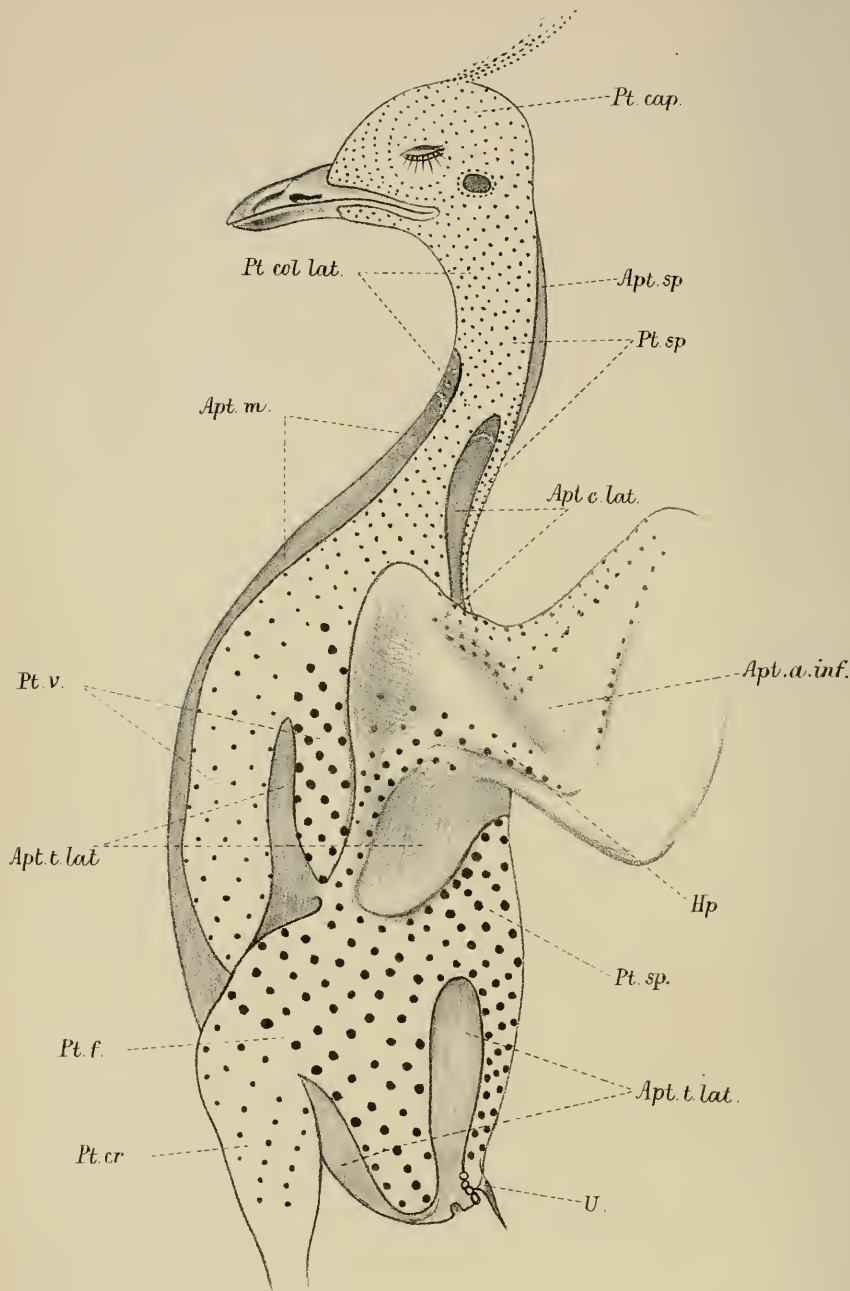
Rhamphotheca.—The compound structure of the Rhamphotheca, or horny beak-sheath, is not apparent in the adult. In the mandible it is suggested by two grooves, one on either side from the gonys, or symphysis of the rami, to the tip. At the base of the upper beak-sheath there is a well-developed cere. Arising from the anterior angle of the external nares, it extends backwards as far as the forehead, so as to be almost level with a line drawn across the head from the anterior corner of the eyelid.

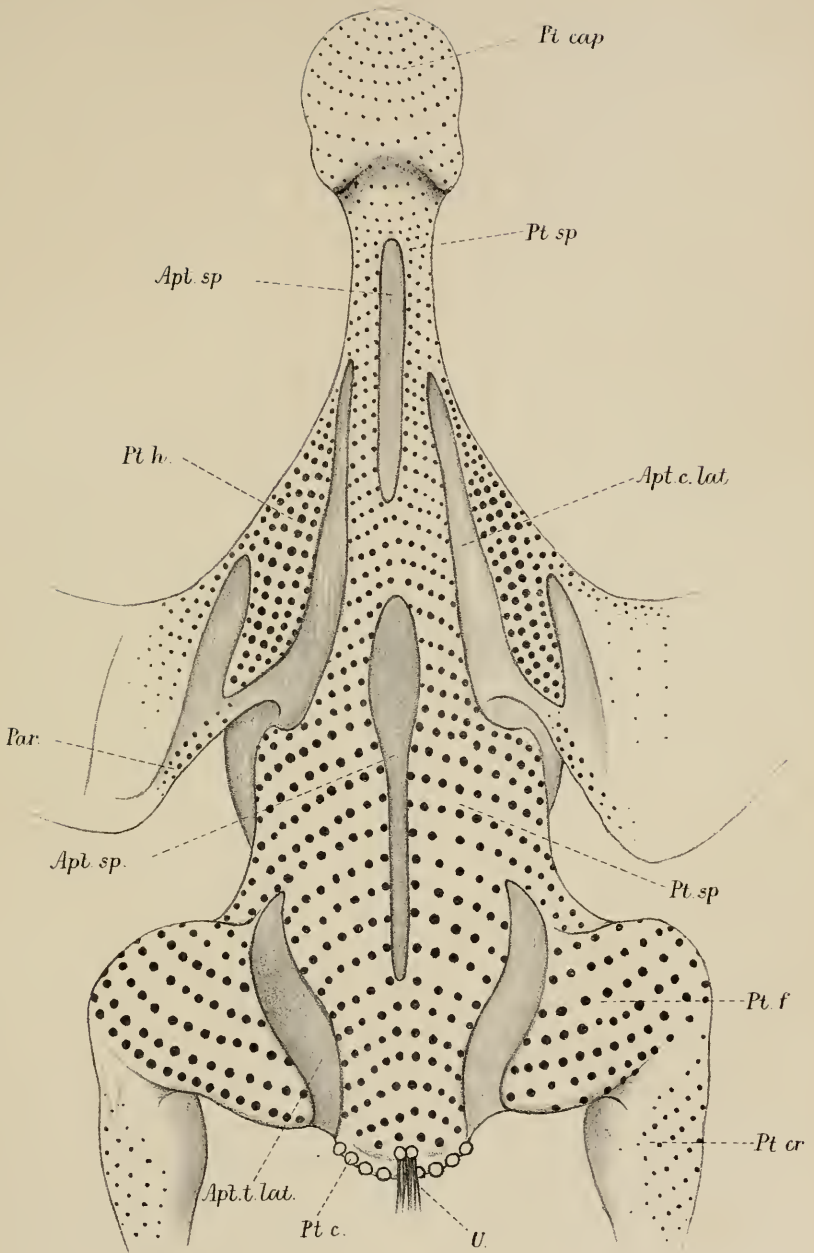
There is no trace of denticulation along the tomia, or of the glandulæ gulares, or of the maxillo-palatine glands described in the nestling (p. 13).

Podotheca.—Acrotarsus reticulate proximally, but rapidly passes into scutellæ, which are continued down to the planta.

Planta.—Reticulate, the scales decreasing somewhat in size from above downwards

Claws.—Short, blunt, and stout, that of the middle toe having the peculiar flange to the inner margin which is so often pectinated in other birds, *e. g.* the Nightjar, Bittern. There is a short conical claw on the index digit of the manus.





2. RHYNCHOTUS RUFESCENS.

An adult moulting specimen of this Tinamou differs in pterylosis from *Calodromas elegans* in the following points:—

Pt. spinalis.—The cervical portion is not branched, but runs in the form of a narrow band down the middle line of the neck. There is a narrow apterion running along the centre of the dorsal moiety of the tract, from between the shoulders to a point corresponding to the anterior end of the ilium, *i. e.* to about the middle of the back.

Pt. caudæ.—The rectrices are hardly, if at all, differentiated from the coverts.

Pt. ventralis.—Of the pectoral portion the outer branch is narrower and the inner somewhat feebly developed.

Pt. humeralis.—Runs forward and downward to join *pt. ventralis*, instead of this tract (*ventralis*) giving off a branch to it.

Pt. alaris.—The carpal remex (see p. 5) only is present, and reduced in size, though still pennaceous.

The *Hyporhachis* (aftershaft) of the tectrices majores, mediæ, and minores of the ventral surface rudimentary, instead of well developed, as in *Calodromas elegans*. The aftershaft of the remainder of the plumage is large.

Apteria:—

Apt. colli lateralis.—Extends far up the neck and is very wide.

Apt. spinalis.—A narrow space extending from between the shoulders to the middle of the back.

Filoplumes.—A few small ones round the base of the remiges.

Eyelashes.—Stronger.

Rhamphotheca.—Fused; no groove on the mandible.

Powder-down.—Absent.

Plumulæ (down-feathers).—Absent, even on the major coverts and remiges (see p. 7).

Claws.—Absent on the wing.

*The Pterylography of the Nestlings of Calodromas elegans
and Nothura maculosa.*

Dr. Sclater has kindly sent me two young birds of the former and one of the latter species. Of these the first two (*C. elegans*) were preserved in spirit, one was "just hatched," and the other was a bird ready to emerge from the shell. The specimen of *Nothura* was "hatched in the incubator," and is a "skin."

Distribution of the Nestling-down-feathers or Neossoptiles.—In examining the pterylosis of nestling birds, it must be remembered that the down-feathers occupy the exact position of the future definitive feathers (true down does not appear till after these feathers are assumed), so that we should expect to find little or no difference between the pterylosis of the adult and nestling. In the present case these conditions obtain.

Pterylosis of the Trunk.—As has just been implied, the pterylosis of this region does not differ from that of the adult, at least so far as I can make out. I ought here to state that the examination of the nestlings was, of necessity, less thorough than that of the adult, inasmuch as in the latter all the feathers were clipped close to the body, a proceeding I felt I ought not to adopt with the young birds. I therefore contented myself with carefully moving aside the plumage while the specimen was fastened down in spirit. There could be no doubt whatever as to the main features, *e. g.* the spinal, cervical, femoral apteria.

Pterylosis of the Wing.—As with the trunk, so with the wing; one or two points, however, deserve notice.

Remiges.—The metacarpo-digital remiges (=primaries) are not so far developed as in a ripe embryo of the common fowl, in that, in the fowl, remiges 1 to 7 (and cubitals of the same number) have pushed their way some distance beyond the post-axial border of the wing. In the present case only the extreme tips of the primaries 4 to 8 have as yet appeared.

The cubital remiges are still less developed, since there is yet no sign of the definitive feathers. The down-feathers,

both of the metacarpo-digital and cubital remiges, are of considerable length.

Tectrices.—Obviously nothing very definite can be said about these feathers at this stage. On the dorsal surface the “downy” major coverts of the cubitus are longer than the remiges, if we may so speak of them. This is interesting, as these portions obtain in the development of these feathers in other birds not at all allied. The length of the “down”-feathers agrees approximately with that of the definite feather which supplants it.

The Structure of the Nestling-down.—The structure of the nestling-down is of peculiar interest on account of its unusual complexity. In both *Calodromas elegans* and *Nothura maculosa* the nestling-down is found to be not of the usual “downy” character, but composed of semi-plumes.

Briefly, a semiplume differs from a down-feather in that in the former the rachis is long and stiff, supporting several pairs of similarly stiff radius-bearing rami, whilst in the latter the rachis, if present, is never stiff, and the rami and radii are long and very delicate, hence the loose flowing structure. A Marabou-plume and a piece of Swan’s-down well illustrate the two types.

Probably the first point which would be noticed in an examination of an individual feather would be the enormous aftershaft (Pl. III. fig. 1, *H.*), which almost equals the main feather in size, the difference in length being very slight. The main feather is composed of a strong shaft, bearing four to six pairs of rami, which decrease in length from below upwards, the free ends giving a gently rounded outline. The rami all bear radii, which are longest on the proximal rami. The rami are produced beyond the most distal radii into long filaments*. By the unaided eye the feathers of the dorsal surface can be sharply differentiated into a distal pennaceous and a proximal downy half; this, of

* In the nestling Ostrich apparently these filaments become much thickened and flattened out, giving the bird the appearance of having been decorated with thin curly horn-shavings.

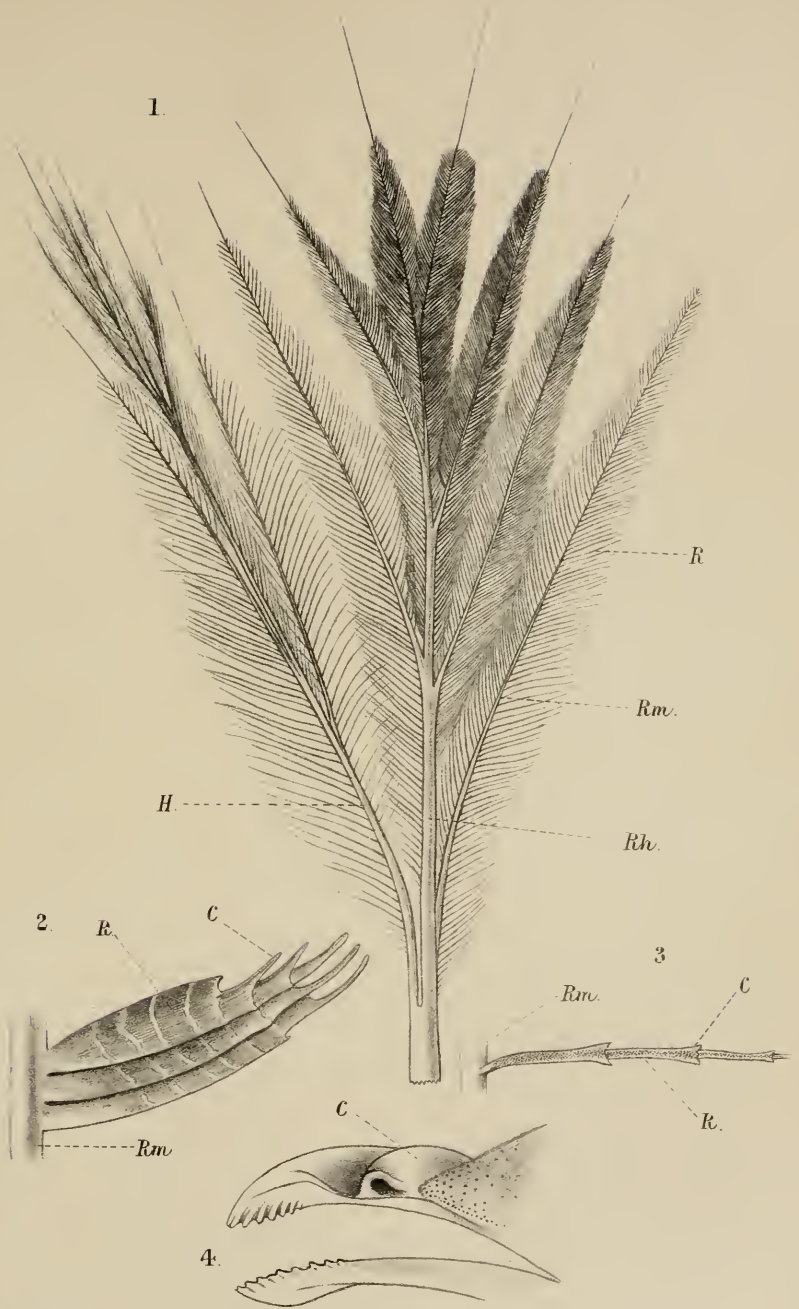
course, is due to the structure of the radii. The calamus is entirely embedded in the skin.

Under a high power of the microscope the radii are seen to be given off in pairs along the rami. Those of the proximal end of the feather are deeply pigmented, the colouring-matter, of the tint of sepia, being dispersed in granules of unequal size and distribution, and imparting a somewhat striated appearance to the radius. Structurally they cannot be said to differ from the downy radii of the definitive feather (Pl. III. fig. 3, p. 7).

The radii of the distal end of the feather are in no wise to be distinguished from those of such pennaceous feathers as do not interlock (Pl. III. fig. 2), yet, by reason of their stiffness and close arrangement, form a vexillum. They are deeply pigmented; the colouring-matter, of the tint of van-dyke-brown, is broken up into oblong masses separated from each other by narrow transparent zones (Pl. III. fig. 2). Towards the tip these radii bear tolerably long cilia. At the proximal end of the rami the radii cross each other, after the fashion of the typical interlocking feather.

The aftershaft, as previously stated, is almost as long as the main stem, and structurally differs only in that the distal rami are pointed so much forward that they run almost directly parallel with the shaft, and this has resulted in a feeble development of the radii, which have been crowded almost out of existence (Pl. III. fig. 1, *H.*).

The presence of an aftershaft, and so greatly developed, is a feature of considerable interest, inasmuch as it had previously been known to occur only in *Dromæus*. Thus, Dr. Gadow says of it (14):—"In *Dromæus* each neossoptile . . . has a short calamus carrying a long dorsal rhachis and a much smaller ventral aftershaft—each of them furnished with from 5 to 6 rami . . . and these again beset with numerous radii without cilia. This is the only known instance of a neossoptile with an appendage, and it is significant that the latter is smaller than the principal shaft, and only in its final stage equals the rhachis in size." Quite recently, however, I have found a fairly well-developed after-



shaft in the nestling-down-feathers of the domestic Turkey and a small one in those of the Common Fowl. These I shall describe hereafter, together with a few other facts of kindred interest.

Uropygial Gland.—The tuft on the gland is barely perceptible.

Rhamphotheca.—The tomia (cutting-edges) of the tip of the beak-sheath of both upper and lower jaws are minutely denticulated (Pl. III. fig. 4), presenting the appearance to the unaided eye (at least in the upper jaw) of a number of tiny, white, closely-crowded teeth. The denticulation of the mandible is slighter and extends further back.

The *rhamphotheca* appears to be compound, that of the upper jaw consisting of a median and two lateral pieces, which fuse distally. The sheath of the lower jaw is similarly divided into a ventral median plate and two lateral plates. The median plate extends from the gonys to the tip of the jaw, where it fuses with the two lateral pieces. Along the distal end of the inner surface of the mandible, in the median line, run two closely approximated ridges, bearing in single file a number of small papillæ—the glandulæ gulares (?). Along the upper jaw in the corresponding region run three such ridges side by side, the central one extending back to the choanæ. These are also provided with papillæ*.

The specimen "taken from the egg" differed from the older bird only in that the oil-gland was less developed and bore no trace of a tuft. The cere also was more tumid. There was an egg-tooth ("Ei-zahn") on the tip of the upper jaw.

The Nestling of Nothura maculosa.

The Nestling-down.—So far as I can make out at present, the "down" of this species differs from that of *Calodromas elegans* only in that the radii of the distal end of the feather were slightly less vigorously developed.

* Whether the *rhamphotheca* is actually compound, and what is the exact nature of the denticulations and papillæ, are questions I have reserved for further investigation. I have the less hesitation in postponing these matters since they are outside the province of pterylography.

The Rhamphotheca was not denticulated. As to the pterylography of this specimen I can say nothing, since, as I have before stated, I have only its skin, and skins do not afford trustworthy data.

It is not advisable here to make any comparison of the two genera just described with the remainder of the order, or even with allied forms, since I think it is obvious that we are not yet in possession of sufficient facts to make such a comparison profitable. If care be taken to correct the errors pointed out in Dr. Gadov's last book, the tables he there gives will be found to contain all that we know at present.

The literature of this subject seems to be of the scantiest character; only three authors can be quoted as containing original statements; all other writers apparently borrow from these or from each other without, in some cases, troubling to acknowledge the source of their information.

A considerable portion of the statements of these authors will now have to be much modified, even in some cases expunged altogether. For brevity's sake I shall quote only such portions of their descriptions as conflict with the fresh facts brought to light in the present paper.

The earliest writer is Nitzsch (1). He described and figured the pterylography of *Crypturus tataupa*, and apparently supplemented his observations by an examination of *C. tao*, *C. variegatus*, and *Rhynchotus rufescens*. He says:—"This genus (*Crypturus*) has two remarkable peculiarities. One of these occurs in the dorsal tract, and consists in the presence of powder-down-feathers, which enclose the dilatation of the hinder part and separate it both from the spaces and from the lumbar tracts (=pt. femoralis). These powder-down-feathers form no true tracts, but are intruded into the gaps of the contour-feathers, so that in *Crypturus* we find true down in these places among the contour-feathers, a peculiarity which occurs in no other Gallinaceous bird." "The second peculiarity consists in the structure of the inferior tract (=pt. ventralis), which is divided very high up, almost at the throat . . . the outer branch

. . . is continued beyond the pectoral boundary, passes through the lateral space of the trunk, and unites with the anterior extremity of the lumbar tract of the same side. Nowhere else have I observed a similar union of the two tracts." Besides these observations he remarked that the tail-feathers are wanting in *C. tataupa* and *Rhynchotus rufescens*, and that he had "never observed any great thickening of the lower half of the shaft of its contour-feathers," though a few pages previously he included these birds in a list of some five others (Gallinaceous birds, with which he placed the Tinamous) which have certain of their feathers "characterized . . . by the enormous width of that portion of the shaft of the contour-feather on which the downy barbs are seated."

Stejneger (12) says:—"The tail-feathers concealed under the coverts or altogether absent . . . Powder-downs are present among the feathers, and in some the feathers have aftershafts."

Gadow appears to have derived the main part of his information from Nitzsch, but has a few remarks relative to the nestling that I take to be original.

In the Anatomischer Theil of his most valuable work (5) he says:—"Tinamidæ, Puderdunen mit den Conturfedern des grossen Sattels der Rückenflur gemischt"; and again, "Wahre Dunen, die theilweise zu Puderdunen umgewandelt sind, finden sich zwischen den Conturfedern des Unterrückens. Dorsalflur . . . keinen Rain enthält."

In his recently-published second volume (6) (Systematischer Theil) the pterylography assumes rather an important place, and such parts as must be discussed here may be collated as follows:—"Vorhandensein von allerdings nur spärlichen Dunen bei den Erwachsenen; einige sind in Puderdunen umgewandelt."

"Alte Dunen nur zwischen den Conturfedern, einige Dunen zu Puderdunen umgewandelt." "Ohne Spinalrain." These statements agree with those of Nitzsch.

The nestling-down is briefly described thus:—"Sehr einfach gebaute, dicht stehende Neossoptile." In the earlier part

of the book the distribution of the down is referred to as "überall."

This then, so far as I can make out, represents all that has been written, all other references having been almost certainly derived from one of these three sources. Let us now briefly analyze these statements.

Nitzsch, as all admit, was a most careful observer, but he does not appear to have noticed the apterium in the spinal tract of *Rhynchotus rufescens*, and this fact allows us room for doubt whether or not it is present in the genus *Crypturus*. The tail-feathers in my specimen of *Rhynchotus rufescens*, as will be shown directly, were present, though, it will be remembered, they were stated to be absent by Nitzsch. In two places reference is made to thick-shafted feathers, the one contradicting the other; so far as my experience goes, this feature of the feathers, notably on the spinal and femoral tracts, is very marked.

Like Nitzsch, it will be noticed, Stejneger states that the tail-feathers in this group are sometimes absent. That they may be but slightly developed is, as we have seen (pp. 2, 9), sometimes the case, but that they are ever entirely wanting is doubtful. Nitzsch, it will be remembered, definitely stated that they were absent in *Crypturus tataupa* and *Rhynchotus rufescens*. In my example of *Rhynchotus* they are in process of moulting, but a few unmoulted feathers remain.

I have not had an opportunity of going carefully into the presence or absence of the aftershaft, but in the few species I have examined I find it developed in various degrees. In *Calodromas elegans*, *Nothura boraquira*, and *Rhynchotus rufescens* it is more than half as long as the main stem; in *Nothocercus julius* it is evidently degenerating, inasmuch as the shaft is almost, if not quite, obsolete, only the rami remaining. In *Tinamus major* I found it reduced to a small shaft bearing a few rami in the case of one single feather; I pulled some three or four more, and there was not the smallest trace of it.

No one appreciates more, or has profited more by, the

invaluable work of Dr. Gadow (5, 6) than I; it is, therefore, in no spirit of captious criticism that I here point out that he has fallen into an error in so unreservedly accepting Nitzsch's work. The error lies in this, that what Nitzsch found in the *Crypturi* Dr. Gadow has applied to the whole of the Tinamiformes, and, as the present paper abundantly proves, such application is incorrect.

The distribution of the down is a point which has probably hitherto been wrongly interpreted. Of the two birds which form the subject of this paper, down-feathers were only present in one—*Calodromas elegans*—and in this bird in a place not previously recorded, viz. on the base of the remiges and major coverts, and nowhere else on the body. The powder-down-feathers of Nitzsch and Gadow will probably prove to be degenerated semiplumes; at any rate, such is the case of the two birds now under discussion. These semiplumes are confined almost entirely to the inner margin of the femoral tract and that portion of the pt. spinalis opposite it, and appear to be nothing more than degenerated contour-feathers of the row to which they belong; there was but one semiplume to each row.

Powder-down-feathers are undoubtedly present in some genera, *e. g.* I have found them in a stuffed specimen of *Tinamus major*. I believe these will prove to be homologous with the semiplumes just described. Are powder-down-feathers the result of the degeneration of semiplumes or of down-feathers?

As touching the simple construction and universal distribution of the nestling-down, it has already been shown that this is not actually the case.

I have endeavoured to restrict the limits of the present paper as much as is compatible with clearness; later I hope to be able to say something further as to the structures of the rhamphotheca and the associated papillæ. The muscular system is just now engaging my attention, and, should anything of interest come to light, I shall not fail to communicate it to the readers of 'The Ibis.'

The net results of this contribution, in so far as taxonomic

questions are concerned, will be found briefly summarized in the appended table.

Tabular Statement contrasting the Results of the present Paper with those of other Writers.

	Nitzsch: describing the genus <i>Crypturus</i> .	Stejneger: describing the Order <i>Cryptari</i> (= <i>Tinamiformes</i>).	Gadow: describing the Order <i>Tinamiformes</i> .	Present paper: describing the genera <i>Cabotromas</i> and <i>Rhyphochotus</i> .
<i>Pteryla spinalis</i>	solid	.....	solid.	with apteria.
" ventralis	divided high up.	.....	.....	in <i>C. elegans</i> divided low
" caudæ (tail-feathers) ..	absent in <i>Crypturus</i> (<i>Rhyphochotus</i>) <i>rufescens</i> .	sometimes absent.	very weak.	very weak.
Hyporhachis (aftershaft)	absent in <i>C. tao</i> .	present in some.	absent or rudimentary.	large.
Pulviplumes (powder-down) ..	present in <i>Crypturus</i> (<i>Rhyphochotus</i>) <i>rufescens</i> .	present.	present.	absent.
Plumulae (down-feathers)	"singly here and there upon the spaces," <i>e. g.</i> lateral spaces of trunk and over the furcula.	.....	present between contour-feathers.	present only in <i>C. elegans</i> , on the base of the remiges and major coverts.
Semiplumæ	"down - feathers become converted into semi-plumes as they approach the contour - feather tracts."	.....	.....	rare, a few along the spinal and femoral tracts appear to equal the powder-down-feathers of Nitzsch and Gadow.
Neosoptile (nestling-down) ..	.....	.....	simple.	complex.
" "	.....	.....	uniformly distributed.	distributed as in adult.

I wish, in conclusion, to record here my grateful thanks to Dr. P. L. Sclater, who has kindly entrusted me with the material for the present investigation.

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Nos. 1, 5, 6, 7, 9, 10, 11, 12 refer only to passages relating

to the pterylography of the *Tinamiformes*; the remaining papers represent the literature of pterylography in general.

EXPLANATION OF THE PLATES.

PLATE I.

Left side view of *Calodromas elegans*, showing the distribution of the pteryllæ (feather-tracts). The shaded parts represent the apteria. Large dots indicate the presence of thick-shafted feathers (p. 8).

<i>Apt.a.inf.</i>	Aptorium alæ inferioris.
<i>Apt.c.lat.</i>	„ colli lateralis.
<i>Apt.t.lat.</i>	„ trunci lateralis.
<i>Apt.m.</i>	„ mesogastreï.
<i>Apt.sp.</i>	„ spinalis.
<i>Pt.cap.</i>	Pterylla capitis.
<i>Pt.col.lat.</i>	„ colli lateralis.
<i>Pt.cr.</i>	„ cruralis.
<i>Pt.f.</i>	„ femoralis.
<i>Pt.sp.</i>	„ spinalis.
<i>Pt.v.</i>	„ ventralis.
<i>Hp.</i>	Hypopteron.
<i>U.</i>	Uropygium (oil-gland).

PLATE II.

Dorsal aspect of *Calodromas elegans*, showing the arrangement of the feather-tracts (pteryllæ). The shaded parts represent the apteria.

Additional Letters.

<i>Pt.c.</i>	Pterylla caudalis.
<i>Pt.h.</i>	„ humeralis.
<i>Par.</i>	Parapteron.

PLATE III.

Fig. 1. A "nestling-down" feather (neossoptile) from the spinal tract of a recently-hatched example of *Calodromas elegans*; magnified and slightly diagrammatic, showing the highly developed radii at the distal end of the feather and the large aftershaft (Hyporhachis), *H*.

Fig. 2. Three radii from the distal end of the feather shown in fig. 1 highly magnified. These radii are apparently composed of a number of segments, such as is shown in fig. 3, which have become fused. The "cilia," it will be noticed, occur only on the penultimate and two preceding segments as a prolongation of the ventral angle of the laminated segment.

Fig. 3. A portion of a radius from the proximal end of fig. 1, highly magnified.

Fig. 4. Beak of a recently-hatched example of *Culodromas elegans*, magnified, showing the denticulations along the cutting-edges of the distal end. Those of the mandible are slightly exaggerated.

References:—*C.* Cere, Cilia; *H.* Hyporhachis; *R.* Radius; *Rm.* Ramus; *Rh.* Rhachis.

II.—*A List of the Birds of the Island of Balâbac, with some Notes on and Additions to the Arifauna of Palâwan.* By A. H. EVERETT, C.M.Z.S., M.B.O.U.

I. BIRDS OF BALÂBAC ISLAND.

BALÂBAC Island is separated from Balambangan, Banguey, and the other islands which cluster around the N.E. extremity of Borneo by the South Balâbac Strait, which leads from the China Sea into the Sulu or Mindoro Sea. This strait is about 26 miles wide to the northward of Balambangan Island, and somewhat wider between Banguey Island and Balâbac, the highest peaks of which two last-named islands lie N. $\frac{1}{2}$ E. and S. $\frac{1}{2}$ W. from each other, $37\frac{1}{2}$ miles apart, so that the islands are plainly visible each from the other. The water in the South Balâbac Strait is for the most part less than 50 fathoms deep, but there is a narrow channel through it in which the soundings vary between 50 and 100 fathoms, though nowhere maintaining the latter depth continuously between the China and Sulu Seas.

The west coast cannot be approached closely on account of numerous coral reefs and shoals, which extend several miles to seaward, but the east coast is bold, with deep water close in-shore. The island is nearly 20 miles long in a due N. and S. direction, and 9 miles broad; and it is generally hilly, the more elevated trends varying from 800 to 1300 feet, whilst Balâbac Peak attains a height of 1890 feet, and forms the culminating point on the island. With the exception of some insignificant clearings, the entire island is densely wooded. The rainfall is very heavy, the driest months being February and March, as on the neighbouring part of the N.W. coast of Borneo.